IEM's AI Modeling: Short-term COVID-19 Projections
Date: 11/22/21

Leveraging over 15 years of support to HHS for medical consequence modeling and our proprietary artificial intelligence (AI) models, IEM believes that our Coronavirus model outputs can be used to assist localities and their medical facilities to better prepare for an increase in hospitalizations, to better plan for and locate drive-through testing facilities, and to determine where increased levels of transmission may be occurring.

We have been refining our AI model over the past month and are confident in its ability to provide accurate 7-day projections that can be used for operational and logistical planning.

AI-based Model Background

IEM is currently using an AI model to fit data from various sources and project new cases of COVID-19. We do <u>not</u> assume the average number of secondary infections (R-value) stays the same over time. IEM's AI model finds the best R-value over time to evaluate how it changes over the course of the outbreak. The IEM modeling team is running ~11 million simulations to fit each state's data and using the best fit for the R-value to project new cases over the next 7 days. The AI models are executed on a daily basis to evaluate the changing dynamics of the COVID-19 pandemic. Our projections have typically been within 10%, and are often within 5%, of actual confirmed cases.

The projections shown in this document are based on data pulled in as of 11/22/21 9 a.m.

Please provide any feedback or send any questions that you might have to us. We are continually updating and improving the model, so your feedback is critical.

Also, if you have more current or refined data for your State, Commonwealth or Territory that you would like IEM to factor in, please let us know.

IEM's Modeling Lead

Dr. Prasith "Sid" Baccam is a **Computational Epidemiologist expert** at IEM with more than **20 years of experience in medical consequence modeling and simulation of disease outbreaks** and medical consequences following hypothetical attacks with biological agents or emerging infectious diseases. He develops key simulation models and decision support tools at IEM, specializing in public health, disaster response, and medical countermeasures (MCM) to enhance data-driven decision making and improve modeling assumptions.

Upon receiving his **Ph.D. in Applied Mathematics and Immunobiology** at Iowa State University, Dr. Baccam worked as a Postdoctoral Research Associate at Los Alamos National Laboratory where he focused on researching viral and immunological modeling. After his stint at Los Alamos, Dr. Baccam has served as Task Lead in multiple public health projects have allowed him to develop expertise as a mathematical biologist and a leader on high-performance modeling and simulation teams.

He has worked with state and local public health officials as well as Federal agencies, including **HHS**, the Centers for Disease Control and Prevention (**CDC**), and the Department of Homeland Security (**DHS**). Dr. Baccam has published numerous papers on public health response models and implications on policy and has been invited to participate in workshops and symposiums held by the Institute of Medicine (now the National Academy of Health). His modeling results have been briefed to the **Executive Office of the President** and informed two presidential policy actions.

New York State Projections
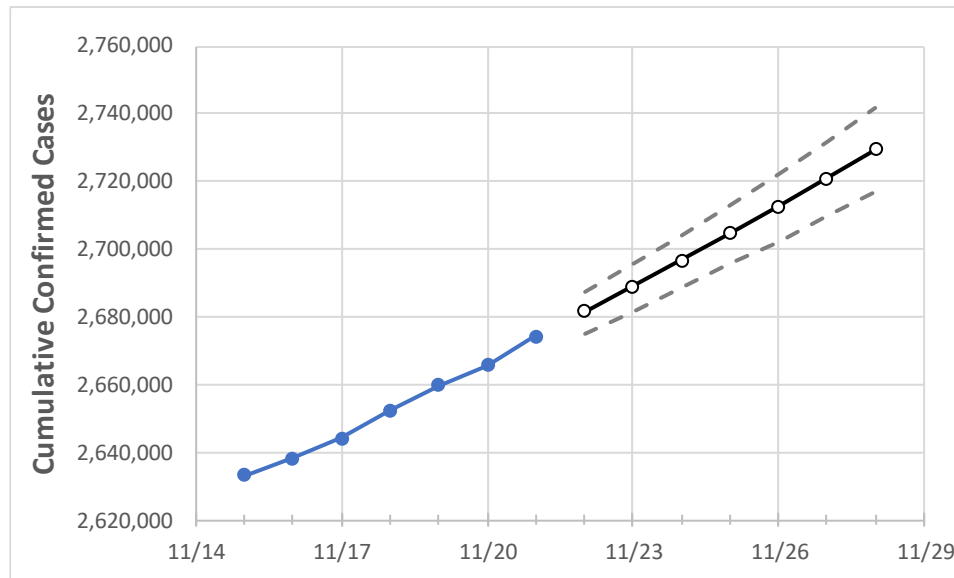
	Actual Confirmed Cases On:				Projected Cases For:						
	11/18	11/19	11/20	11/21	11/22	11/23	11/24	11/25	11/26	11/27	11/28
New York	2,652,280	2,659,870	2,665,759	2,674,200	2,681,587	2,689,038	2,696,691	2,704,562	2,712,693	2,720,931	2,729,370

Note: The State's projection shows a "best estimate" curve (the solid line with circles) and the dotted lines are the upper and lower estimates around that best estimate. Our projections have typically been within 10%, and are often within 5%, of actual confirmed cases.

New York Counties

	Actual Confirmed Cases On:				Projected Cases For:						
	11/18	11/19	11/20	11/21	11/22	11/23	11/24	11/25	11/26	11/27	11/28
Albany	33,202	33,316	33,432	33,536	33,644	33,753	33,862	33,976	34,092	34,208	34,324
Bronx	211,240	211,445	211,683	211,920	212,143	212,380	212,629	212,886	213,157	213,431	213,723
Dutchess	37,100	37,201	37,287	37,367	37,449	37,532	37,617	37,705	37,796	37,888	37,981
Erie	117,550	118,219	118,893	119,565	120,256	120,963	121,694	122,445	123,230	124,034	124,860
Kings	344,390	344,914	345,438	345,962	346,477	347,006	347,543	348,085	348,643	349,209	349,780
Monroe	92,914	93,377	93,821	94,310	94,812	95,320	95,849	96,385	96,935	97,502	98,093
Nassau	221,030	221,437	221,880	222,290	222,706	223,134	223,581	224,034	224,509	224,998	225,491
New York	173,352	173,678	174,011	174,361	174,673	174,988	175,315	175,650	175,995	176,345	176,712
Niagara	26,855	27,026	27,179	27,372	27,551	27,737	27,929	28,125	28,328	28,537	28,754
Onondaga	56,962	57,247	57,449	57,751	57,991	58,241	58,487	58,751	59,012	59,282	59,540
Orange	60,401	60,561	60,716	60,861	61,016	61,175	61,335	61,498	61,666	61,838	62,010
Putnam	12,875	12,905	12,920	12,937	12,953	12,970	12,987	13,005	13,021	13,039	13,058
Queens	321,992	322,390	322,811	323,231	323,643	324,067	324,508	324,963	325,422	325,907	326,392
Rensselaer	16,466	16,540	16,649	16,716	16,799	16,881	16,964	17,048	17,137	17,225	17,317
Richmond	91,267	91,384	91,503	91,621	91,733	91,848	91,965	92,085	92,205	92,330	92,456
Rockland	54,686	54,756	54,824	54,877	54,941	55,003	55,068	55,133	55,198	55,266	55,332
Saratoga	22,854	23,037	23,236	23,402	23,562	23,736	23,905	24,084	24,269	24,458	24,650
Schenectady	18,395	18,479	18,599	18,687	18,777	18,870	18,963	19,059	19,159	19,263	19,362
Suffolk	248,796	249,417	250,019	250,605	251,172	251,763	252,348	252,966	253,599	254,264	254,911
Sullivan	9,135	9,174	9,208	9,239	9,275	9,311	9,348	9,385	9,425	9,464	9,503
Tompkins	7,063	7,088	7,121	7,186	7,218	7,254	7,288	7,324	7,363	7,401	7,440
Ulster	18,320	18,403	18,463	18,523	18,590	18,657	18,727	18,800	18,875	18,953	19,032
Westchester	146,255	146,400	146,579	146,735	146,895	147,061	147,231	147,406	147,586	147,772	147,960

Some recipients of our daily COVID-19 short-term (7 day) projections have requested projections of demand for: hospital bed, intensive care unit (ICU) beds, and mechanical ventilation. We realize that different states and localities will have different characteristics for hospital demand of COVID-19 cases, and we are presenting the best assumptions we could find for those medical demands based on scientific literature and health data reporting. Specifically:

- *Beds: For hospitalization, we use a range of 10% and 20% of cases require hospitalization based on CDC's report (MMWR, March 18, 2020) and state reports of COVID-19 cases.*
- *ICU: The CDC report found that 24% of hospitalized cases require ICU care.*
- *Ventilators: Based on clinical data from China and state reports, we assume that 50% of ICU cases require a ventilator.*

If you have other estimates for these assumptions, please share them with us as we work to refine our modeling, assumptions, and data on a daily basis.

*The medical demands shown in the table assume 20% of **cumulative** confirmed cases require hospitalization. To get the medical demand for the assumption that 10% of confirmed cases require hospitalization, simply divide the demand by 2.*

New York Medical Demands by County

	Actual Confirmed Cases On:				Projected Cases (Hospitalized) [ICU] {Ventilator} For:		
	11/18	11/19	11/20	11/21	11/23	11/25	11/27
Albany	33,202	33,316	33,432	33,536	33,753 (6,751) [1,620] {810}	33,976 (6,795) [1,631] {815}	34,208 (6,842) [1,642] {821}
Bronx	211,240	211,445	211,683	211,920	212,380 (42,476) [10,194] {5,097}	212,886 (42,577) [10,219] {5,109}	213,431 (42,686) [10,245] {5,122}
Dutchess	37,100	37,201	37,287	37,367	37,532 (7,506) [1,802] {901}	37,705 (7,541) [1,810] {905}	37,888 (7,578) [1,819] {909}
Erie	117,550	118,219	118,893	119,565	120,963 (24,193) [5,806] {2,903}	122,445 (24,489) [5,877] {2,939}	124,034 (24,807) [5,954] {2,977}
Kings	344,390	344,914	345,438	345,962	347,006 (69,401) [16,656] {8,328}	348,085 (69,617) [16,708] {8,354}	349,209 (69,842) [16,762] {8,381}
Monroe	92,914	93,377	93,821	94,310	95,320 (19,064) [4,575] {2,288}	96,385 (19,277) [4,626] {2,313}	97,502 (19,500) [4,680] {2,340}
Nassau	221,030	221,437	221,880	222,290	223,134 (44,627) [10,710] {5,355}	224,034 (44,807) [10,754] {5,377}	224,998 (45,000) [10,800] {5,400}
New York	173,352	173,678	174,011	174,361	174,988 (34,998) [8,399] {4,200}	175,650 (35,130) [8,431] {4,216}	176,345 (35,269) [8,465] {4,232}
Niagara	26,855	27,026	27,179	27,372	27,737 (5,547) [1,331] {666}	28,125 (5,625) [1,350] {675}	28,537 (5,707) [1,370] {685}
Onondaga	56,962	57,247	57,449	57,751	58,241 (11,648) [2,796] {1,398}	58,751 (11,750) [2,820] {1,410}	59,282 (11,856) [2,846] {1,423}
Orange	60,401	60,561	60,716	60,861	61,175 (12,235) [2,936] {1,468}	61,498 (12,300) [2,952] {1,476}	61,838 (12,368) [2,968] {1,484}
Putnam	12,875	12,905	12,920	12,937	12,970 (2,594) [623] {311}	13,005 (2,601) [624] {312}	13,039 (2,608) [626] {313}
Queens	321,992	322,390	322,811	323,231	324,067 (64,813) [15,555] {7,778}	324,963 (64,993) [15,598] {7,799}	325,907 (65,181) [15,644] {7,822}
Rensselaer	16,466	16,540	16,649	16,716	16,881 (3,376) [810] {405}	17,048 (3,410) [818] {409}	17,225 (3,445) [827] {413}
Richmond	91,267	91,384	91,503	91,621	91,848 (18,370) [4,409] {2,204}	92,085 (18,417) [4,420] {2,210}	92,330 (18,466) [4,432] {2,216}
Rockland	54,686	54,756	54,824	54,877	55,003 (11,001) [2,640] {1,320}	55,133 (11,027) [2,646] {1,323}	55,266 (11,053) [2,653] {1,326}
Saratoga	22,854	23,037	23,236	23,402	23,736 (4,747) [1,139] {570}	24,084 (4,817) [1,156] {578}	24,458 (4,892) [1,174] {587}
Schenectady	18,395	18,479	18,599	18,687	18,870 (3,774) [906] {453}	19,059 (3,812) [915] {457}	19,263 (3,853) [925] {462}
Suffolk	248,796	249,417	250,019	250,605	251,763 (50,353) [12,085] {6,042}	252,966 (50,593) [12,142] {6,071}	254,264 (50,853) [12,205] {6,102}
Sullivan	9,135	9,174	9,208	9,239	9,311 (1,862) [447] {223}	9,385 (1,877) [450] {225}	9,464 (1,893) [454] {227}
Tompkins	7,063	7,088	7,121	7,186	7,254 (1,451) [348] {174}	7,324 (1,465) [352] {176}	7,401 (1,480) [355] {178}
Ulster	18,320	18,403	18,463	18,523	18,657 (3,731) [896] {448}	18,800 (3,760) [902] {451}	18,953 (3,791) [910] {455}
Westchester	146,255	146,400	146,579	146,735	147,061 (29,412) [7,059] {3,529}	147,406 (29,481) [7,075] {3,538}	147,772 (29,554) [7,093] {3,547}

For additional information from IEM, please contact Bryan Koon, Vice President of Emergency Management and Homeland Security at bryan.koon@iem.com or 850-519-7966 or Stephanie Tennyson at stephanie.tennyson@iem.com or 202-309-4257.